CAPILLARY COLLAPSE AND PINCHOFF OF A SOAP-FILM BRIDGE

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The dynamics of inviscid capillary breakup of an axisymmetric soapfilm bridge subject to a density jump are investigated numerically. We will consider a model flow that consists of an axisymmetric bubble which pinches at two points on the axis of symmetry, disconnecting into a satellite bubble and two end pieces. At the disconnection time, the satellite bubble forms a cone in the region near pinchoff, while the remaining film has the shape of a crater. The cone-crater structure is expected to form in a self-similar manner. We are interested in understanding the details of the cone-crater structure and in the dependence of this local structure as well as large scale quantities such as satellite bubble size and formation time on the density jump across the film.

Computationally, the flow is modelled by an inviscid axisymmetric vortex sheet with constant surface tension. Previous computations of such sheets have proven to be difficult due to instabilities, stiffness of the governing system, and inaccuracies near the axis. We will review different approaches to compute the flow, and present a method using dynamic meshrefinement which is applied to resolve the flow.

The results are used to study the self-similar collapse of the cone-crater structure near pinchoff in detail, for the case of zero density jump. For nonzero density jumps, we find that the shape at pinchoff on the crater side, but not on the cone side, depends significantly on the density jump, as well as the size of the satellite bubble and the time of disconnection.